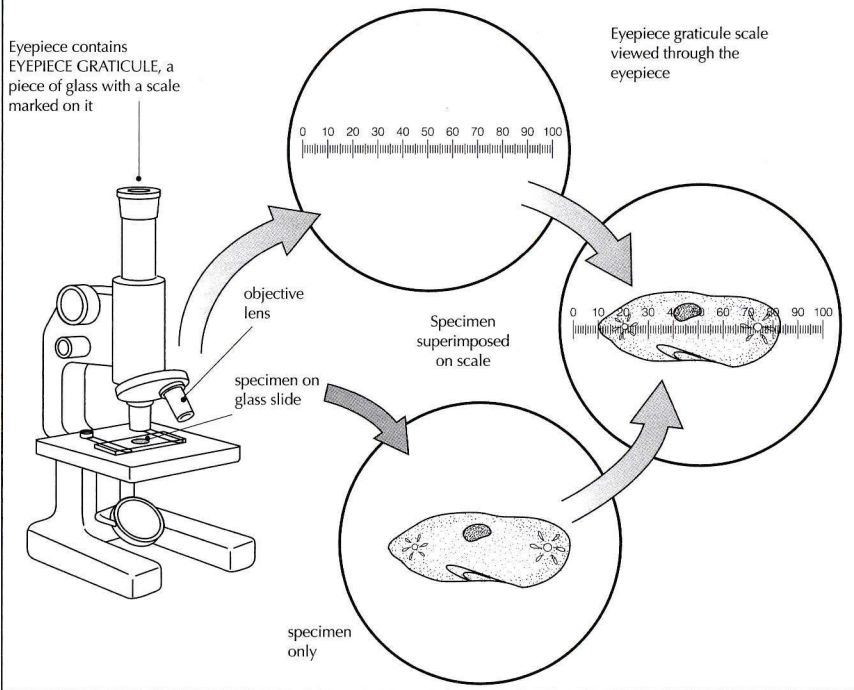
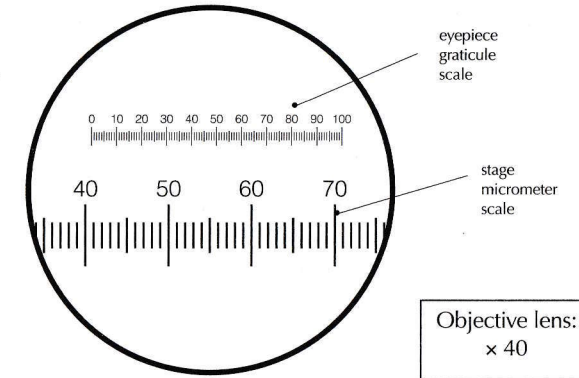


Measuring length with a microscope: micrometry



Using a stage micrometer: this is a microscope slide with a scale, of known length, marked on it, i.e. we know exactly how much each division on the micrometer measures (usually each division = 0.1 mm).



The stage micrometer is then used to calculate how much each division on the eyepiece graticule measures.

Specimen could be compared with others, but to measure its actual length the graticule must be **calibrated** (we must know the actual length represented by each division on the scale).

The higher the magnification, the fewer micrometer divisions will 'line up' with the graticule.
In this example: at total magnification $\times 400$
($\times 10$ eyepiece, $\times 40$ objective)
100 graticule units = 25 micrometer divisions
= 25×0.1 mm
= 2.5 mm = 2 500 μ m
So 1 graticule unit = 25 μ m

SI (Systeme Internationale) units of length are related to each other by 1000 (10^3)

1 m = 1000 mm	1 mm = $\frac{1}{1000}$ m
1 mm = 1000 μ m	1 μ m = $\frac{1}{1000}$ mm
1 μ m = 1000 nm	1 nm = $\frac{1}{1000}$ μ m

Magnification is the number of times larger an image is than an object. So

$$\text{Magnification} = \frac{\text{size of image}}{\text{size of object}} = \frac{\text{measured length}}{\text{actual length}}$$

- because this is a ratio **there are no units**;
- the same unit must be used for both the size of the image and the size of the object, so some conversion might be necessary, image measures 70 mm and object measures 3.5 μ m e.g.

Convert image size to μ m: 70 mm = 70 000 μ m

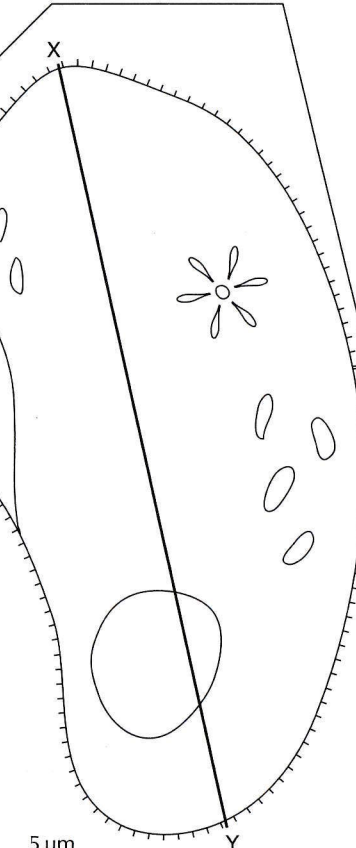
$$\text{So magnification} = \frac{70\,000}{3.5} = 20\,000 \text{ (usually written } \times 20\,000 \text{)}$$

Remember it like this!

$$\text{Magnification} = \frac{\text{Measured}}{\text{Actual}}$$

You need two out of three!

If you remember $\text{Mag} = \frac{\text{Measured}}{\text{Actual}}$, you can answer any question if you are given or can measure two of these three quantities.



For example

The scale bar **measures** 20 mm = 20 000 μ m
The **actual** length is given as 5 μ m

$$\text{So magnification} = \frac{20\,000}{5} = \times 4000$$

To work out the **actual** size of the specimen, measure X-Y

$$\text{Then } 4000 = \frac{\text{measured X-Y}}{\text{actual X-Y}}, \text{ so}$$

$$\text{Actual X-Y} = \frac{\text{measured X-Y}}{4000}$$